

Type Ia supernovae 2014J and 2011fe at the nebular phase

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Abstract

© 2015, Pleiades Publishing, Inc. We present our observations and the results of our analysis of the nebular spectra for two nearby type Ia supernovae (SN 2014J and SN 2011fe). For the overall picture, we have analyzed the nebular spectra of four other type Ia supernovae. All of the investigated supernovae show evidence of a significant shift in the [Co III], [Fe III], [Fe II], and [Ni II] lines ($\sim 103 \text{ km s}^{-1}$) at a late nebular phase ($t \sim 250\text{--}300$ days). The shifts in the lines of singly and doubly ionized species differ noticeably, suggesting a difference of the departures from symmetry in the inner and outer ejecta. In SN 2014J, the [Fe III] and [Fe II] line shifts are comparable in absolute value and opposite in sign. This means that the shift in the centroid of the ^{56}Ni distribution is probably small compared to the width of the velocity distribution. The [Ni II]/[Fe II] flux ratio for the six supernovae suggests that, on average, the $^{58}\text{Ni}/^{56}\text{Fe}$ ratio for SNe Ia is nearly solar, in agreement with the dominant contribution of SNe Ia to the galactic synthesis of iron-peak elements. The nebular spectra of SN 2014J and SN 2011fe are shown to rule out the presence of stripped hydrogen from the normal companion in the amount predicted by the scenario of a binary system with a normal companion.

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Keywords

nucleosynthesis, supernovae